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HISTORIC AMERICAN ENGINEERING RECORD

INDEX TO PHOTOGRAPHS

Jet Propulsion Laboratory Edwards Facility, Test Stand D, (Building 4223/E-24)
Edwards Air Force Base
Boron Vicinity
Kern County
California

HAER No. CA-163-F

Photographers' Credits:

Credit BG: Brian Grogan, Yosemite Photographics, Inc. December 1994/January 1995
Credit WCT: William C. Tibbitts, Photographer, Jet Propulsion Laboratory, Edwards Facility (dates cited in captions)
Credit JPL: JPL staff photographers, Jet Propulsion Laboratory, Edwards Facility (names undetermined, dates cited in captions)
Credit GE: George Emmerson, Photographer, Jet Propulsion Laboratory, Edwards Facility (dates cited in captions)
Credit SMH: Scott M. Hudlow, Architectural Historian, Computer Sciences Corporation, Edwards Air Force Base, November 1994/March 1995

CA-163-F-1 Photographic copy of site plan for proposed Test Stand "D" in 1958. The contemporary site plans of test stands "A," "B," and "C" are also visible, along with the interconnecting tunnel system. California Institute of Technology, Jet Propulsion Laboratory, Plant Engineering "Site Plan for Proposed Test Stand "D" - E[dwards] T[est] S[tation]," drawing no. ESP/22-0, 14 November 1958.

CA-163-F-2 Credit WCT. Photographic copy of photograph, view looking south down easternmost tunnel axis during second phase of JPL tunnel construction in 1959. Reinforced concrete formwork for Test Stand "D" foundation appears in left foreground. Formwork for Building 4222/E-23 (Test Stand "D" Workshop) is in place in right foreground with disturbed earth for western leg of tunnel system evident in background. Test Stand "C" is in center background, where first phase of tunnel construction ended. Test Stand "A" appears as tower in right background. (JPL negative no. 384-1838-C, 9 March 1959)

CA-163-F-3 Credit WCT. Photographic copy of photograph, view looking southeast across formwork for reinforced concrete base of Test Stand "D," with tunnel extension in foreground. (JPL negative no. 384-1838-D, 9 March 1959)

CA-163-F-4 Credit WCT. Photographic copy of photograph, view looking north at Test Stand "D" engine exhaust gas deflector or "flame bucket" just after its installation. This device was water-cooled. It also injected sprays of water into the gas flow to cool the exhaust down. (JPL negative no. 384-1861-A, 8 April 1959)

CA-163-F-5 Credit WCT. Photographic copy of photograph, view looking east at Test Stand "D" during erection of the test stand tower. Note wire lath nailed over gypsum board on Building 4222/E-23 at far left in preparation for stucco covering (temporary construction). Stucco would not require painting in desert. (JPL negative no. 384-1865-A, 13 April 1959)

CA-163-F-6 Credit WCT. Photographic copy of photograph, oxidizer and fuel tank assembly for engine tests being raised by crane for permanent installation in Test Stand "D" tower. Each tank held 170 gallons of propellants. (JPL negative 384-2029-B, 7 August 1959)

CA-163-F-7 Credit WCT. Photographic copy of photograph, view of Test Stand "D" from Test Stand "A" while a rocket engine test is in progress. Cloud of steam is from partly from water created by propellant reaction and from water sprayed by flame bucket into engine exhaust for cooling purposes. A portion of Test Stand "C" is visible at the far right. (JPL negative no. 384-2082-B, 23 October 1959)

CA-163-F-8 Credit WCT. Photographic copy of photograph, looking southwest across east side of Test Stand "D" while work is in progress to install conduit for new Dd horizontal test station. (JPL negative no. 384-2248-B, 3 May 1960)

CA-163-F-9 Credit WCT. Photographic copy of photograph, view looking northwest at complete Test Stand "D"

installation as of January 1962. Note closed-circuit television camera at extreme left, along with MMH (fuel) storage tank. Hatch of Dd test cell is open; nearby stand MMH run tanks for Dd station. (JPL negative no. 384-2591-A, 25 January 1961)

CA-163-F-10 Credit WCT. Photographic copy of photograph, view looking northeast down onto new Dd test station from Test Stand "D" tower. Hatch of Dd test cell is open, and a test engine sits on a dolly nearby awaiting mounting. Note the water-cooled diffuser on the east end of the test chamber; this was soon replaced with a new diffuser and a steam-driven ejector for simulated high-altitude tests. A closed circuit television camera is mounted on the west end of the test cell. At the lower left of the view are fuel and oxidizer run tanks which supply propellants for test runs. (JPL negative no. 384-2650-A, 8 February 1961)

CA-163-F-11 Credit WCT. Photographic copy of photograph, low level aerial view of Test Stand "D," looking due west, after completion of Dd station installation in 1961. Note Test Stand "D" "neutralization pond" to immediate southeast of tower. (JPL negative no. 384-2997-B, 12 December 1961)

CA-163-F-12 Credit WCT. Photographic copy of photograph, low level aerial view of Test Stand "D," looking due south, after completion of Dd station installation in 1961. Note Test Stand "D" "neutralization pond" to immediate southeast of tower. A steel barrier north of and parallel to the Dd station separates fuel run tanks (on south side obscured from view) from oxidizer run tanks (on north side). Small Dj injector test stand is visible to the immediate left of oxidizer run tanks; it is oriented on a northeast/southwest diagonal to the Dd test station. The large tank to the north of the oxidizer run tanks (near center bottom of view) is an oxidizer storage tank for nitrogen tetroxide. Slender tanks to the northwest of the tower (lower right of view) contain high pressure nitrogen gas. A large vertical tank at the base of the tower contains distilled water for flushing propellant lines. (JPL negative no. 384-2997-B, 12 December 1961)

CA-163-F-13 Credit WCT. Photographic copy of photograph, view northwest at Test Stand "D" tower with Dd station to right and "neutralization pond" in foreground. Note tunnel entrance way in left background. (JPL negative no. 384-3356-B, 20 November 1962)

CA-163-F-14 Credit WCT. Photographic copy of photograph, view north across "neutralization pond" at Test Stand "D," showing complete Dd station with new Y-Stage and Z-Stage steam-driven ejectors, and "Hyprox" steam generator which powered ejectors. (JPL negative no. 384-3356-B, 20 November 1962)

CA-163-F-15 Credit WCT. Photographic copy of photograph, view east southeast across Dd station ejectors showing detail of "Hyprox" steam generator. Note that steam generator is placed above Z-stage ejector; an insulated pipe running between the Dd train rails supplies steam to the Y-Stage ejector. Note emergency eyewash stand at extreme right of view. (JPL negative no. 384-3376, 3 December 1962)

CA-163-F-16 Credit WCT. Photographic copy of photograph, interior view of Dd test cell with VO (*Viking Orbiter*)-75 spacecraft engine mounted for testing. (Viking was a Mars orbiter and lander mission.) The end of the engine nozzle is inserted into a diffuser in order to conduct exhaust gases out of the chamber. All piping and tubing is stainless steel. Note ports in background through which instrumentation wiring passes. Nozzles at top of view are part of an internal fire suppression (or "Firex") system. (JPL negative no. 384-9428, 24 April 1972)

CA-163-F-17 Credit WCT. Photographic copy of photograph, in 1963 a "Y" branch connector was introduced at the Dd test station in order to add a second test cell (named Dy) to the Dd train of coolers and ejectors. This view shows the diffuser used to connect the Dy test chamber with the "Y" branch. This Dy chamber was the second one installed at this station; it was later moved and incorporated into a larger horizontal test station retaining the Dy designation. (JPL negative no. 384-11176-B, 17 May 1976)

CA-163-F-18 Credit BG. View looking northeast at southwestern side of Test Stand "D" complex. Test Stand "D" workshop (Building 4222/E-23) is at left; shed to its immediate right is an entrance to underground tunnel system which interconnects all test stands. To the right of Test Stand "D" tower are four Clayton water-tube flash boilers once used in the Steam Generator Plant 4280/E-81 to power the vacuum ejector system at "D" and "C" stands. A corner of 4280/E-81 appears behind the boilers. Boilers were removed as part of stand dismantling program. The Dv (vertical vacuum) Test Cell is located in the Test Stand "D" tower, behind the sunscreen on the west side. The top of the tower contains a hoist for lifting or lowering rocket engines into the Dv Cell. Other equipment mounted in the tower is part of the steam-driven vacuum ejector system.

CA-163-F-19 Credit BG. Test Stand "D" tower as seen looking northeast (See caption for CA-163-F-18). To the right of the view is the stainless steel dome top for Dv Cell (see CA-163-F-22 for view into cell), behind which rests a spherical accumulator--an electrically heated steam generator for powering the vacuum system at "C" and Test Stand "D." Part of the ejector system can be seen on the right corner of the tower, other connections include electrical ducts (thin, flat metal members) and fire protection systems. Note the stand in the foreground with lights used to indicate safety status of the stand during tests.

CA-163-F-20 Credit BG. West elevation of Test Stand "D" tower, with workshop on left, and tunnel entrance at right. Tower is accessed by exterior steel stairway; the vertical vacuum cell (Dv Cell) is obscured behind large square sunscreen. Below the sunscreen can be seen the end of the horizontal vacuum duct leading from the vacuum cell.

CA-163-F-21 Credit BG. Looking southeast at Test Stand "D" (Building 4223/E-24). Left foreground contains six high-pressure nitrogen tanks which supplied nitrogen for operation of propellant valves. Several tanks for other substances have been removed from the base of the tower as part of decontamination and dismantling program. The vertical vacuum test cell can be seen in the tower

shaped vertical pipes atop the accumulator are burst-disk type safety valves. The ejector ends of the Dd and Dy trains are visible to the right. Tracks permitted each train to expand and contract with temperature or equipment changes.

CA-163-F-25 Credit WCT. Photographic copy of photograph, view of Test Stand "D" from the south with tower ejector system in operation during a 1972 engine test. Note steam evolving from Z-stage ejectors atop the interstage condenser in the tower. Note also the "Hyprox" steam generator straddling the Dd ejector train to the right. The new Dy horizontal train has not been erected as of this date. In the distance is Test Stand "E." (JPL negative no. 384-9766-AC, 28 November 1972)

CA-163-F-26 Credit WCT. Photographic copy of photograph, installation of new accumulator next to Dd station. (JPL negative no. 344-2516-A, 29 August 1977)

CA-163-F-27 Credit BG. View west of Test Stand "D" complex, with ends of Dd (1eft) and Dy (right) station ejectors in view. Steam piping from accumulator (sphere) to ejectors is apparent; long horizontal loops in the pipes permit expansion and contraction without special joints. The small platform straddling the Dd ejector (near the accumulator) was originally constructed for a "Hyprox" steam generator which supplied steam to the Dd ejector before the accumulator and Dy stand were built. Note ejectors on top of interstage condenser in Test Stand "D" tower. Metal shed in far right background is for storage.

CA-163-F-28 Credit WCT. Photographic copy of photograph, view east showing the Y-stage ejector nozzle as the Y-stage ejector is being installed in the Dd ejector train in 1962. In the distance can be seen the western end of the Z-stage ejector. (JPL negative no. 384-3345-A, 8 November 1962)

CA-163-F-29 Credit WCT. Photographic copy of photograph, view west into Dd or Dy ejector, showing steam nozzles which drive the ejector to evacuate the test cell to which it is connected. (JPL negative no. 344-2516-B, 29 August 1977)

behind the western sunscreen. At the top of the tower in the northeast corner is the interstage condenser used in the series of vacuum ejectors; at the top of the condenser is one of two Z-stage ejectors used to evacuate the condenser. The hoist beam for lifting/lowering rocket engines can be clearly seen projecting to the west over the pavement. In the distance on the right are Clayton water-tube steam generators from Building 4280/E-81, and the towers for Test Stand "C" and its scrubber-condenser.

CA-163-F-22 Credit BG. View looking west down into Test Stand "D" vertical vacuum cell with top removed. Access to cell is normally through large round port seen in view. Piping and cradling toward bottom of cell was last used in tests of Viking space probe engines.

CA-163-F-23 Credit BG. View looking northeast down from the tower onto the two horizontal test stations at Test Stand "D." Station Dy is at the far left (Dy vacuum cell out of view), with in-line exhaust gas cooling sections and steam-driven "air ejector" (or evacuator) discharging engine exhausts to the east. The Dd cell is visible at the lower left, and the Dd exhaust train has the same functions as at Dy. The spherical tank is an electrically heated "accumulator" which supplies steam to the ejectors at Dv, Dd, and Dy stations. Other large piping delivered cooling water to the horizontal train cooling sections. The horizontal duct at the "Y" branch in the Dd train connects the Dd ejector to the Dv and Cv vacuum duct system (a blank can be bolted into this duct to isolate the Dd system). The shed roof for the Dpond test station appears at bottom center of this image. The open steel frame to the lower left of the image supports a hoist and crane for installing or removing test engines from the Dd test cell.

CA-163-F-24 Credit BG. Looking northwest at the Dd stand complex. To the left is the Test Stand "D" tower with steam-driven ejectors and interstage condenser visible along with steam lines. The steam accumulator appears in the left foreground (sphere); steam lines emerging from the top conduct steam to the Dv, Dd, and Dy stand ejectors. The T-

CA-163-F-30 Photographic copy of plan of new Dy horizontal station and accumulator additions to Test Stand "D," also showing existing Dd test station. JPL drawing by VTN Consolidated, Inc. Engineers, Architects, Planners, 2301 Campus Drive, Irvine, California 92664: "Jet Propulsion Laboratory-Edwards Test Station, Motive Steam Supply & Ejector Pumping System: Plan - Test Stand "D," sheet M-3 (JPL sheet number E24/33), 21 December 1976.

CA-163-F-31 Credit SMH. Photographic copy of photograph, detail of Dpond test station (looking southwest) built in the 1970s by JPL personnel to test small spacecraft thrusters (5 pounds thrust). March 1995.

CA-163-F-32 Credit BG. View looking southwest at Test Stand "D" complex. In the background at left is the Steam Generator Plant 4280/E-81 built in 1972 to house four gas-fired Clayton flash boilers. The boilers were later supplemented by the electrically heated steam accumulator (sphere) to supply steam to the various ejectors at Test Stand "D" vacuum test cells.